

09/700687

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191S143 GB  
SEQUENCE LISTING

<110> COMPAGNIE GERVAIS DANONE  
GENDRE, François  
BENBADIS, Laurent  
BRIGNON, Pierre

<120> MUTANT LACTOBACILLUS BULGARICUS STRAINS FREE  
FROM BETA-GALACTOSIDASE ACTIVITY

<130> MJPcb191/143

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<150> FR9806456

<151> 1998-05-22

<160> 3

<170> PatentIn Ver. 2.1

<210> 1

<211> 5059

<212> DNA

<213> Lactobacillus bulgaricus

<220>

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<222> (122)..(1873)

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<222> (1877)..(4519)

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Met Ile Phe Ile Ile Thr Asn Leu Ile Thr Ala Ile Arg Ile Gly Glu  
1 5 10 15

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cgg	tgg	ggg	aag	ttc	aag	ccc	tgg	gtt	gtg	ggc	ggg	ggg	atc	atc	agc	265
Arg	Trp	Gly	Lys	Phe	Lys	Pro	Trp	Val	Val	Gly	Gly	Gly	Ile	Ile	Ser	
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Ser	Leu	Ala	Leu	Leu	Ala	Leu	Phe	Thr	Asp	Phe	Gly	Gly	Ile	Asn	Gln	
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Ser	Asn	Pro	Val	Val	Tyr	Leu	Val	Ile	Phe	Gly	Ile	Val	Tyr	Leu	Ile	
	65				70				75					80		
atg	gat	atc	ttc	tac	tca	ttt	aaa	gac	act	ggc	ttc	tgg	gcc	atg	atc	409
Met	Asp	Ile	Phe	Tyr	Ser	Phe	Lys	Asp	Thr	Gly	Phe	Trp	Ala	Met	Ile	
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ccg	gcc	ttg	tcc	ctg	gat	tcc	cg	gaa	aga	gag	aag	acc	tcc	acc	ttc	457
Pro	Ala	Leu	Ser	Leu	Asp	Ser	Arg	Glu	Arg	Glu	Lys	Thr	Ser	Thr	Phe	
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Ala	Arg	Val	Gly	Ser	Thr	Ile	Gly	Ala	Asn	Leu	Val	Gly	Val	Val	Ile	
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acc	cca	atc	atc	ctc	ttc	ttc	tcg	gcc	agc	aag	gcc	aac	ccc	aac	ggg	553
Thr	Pro	Ile	Ile	Leu	Phe	Phe	Ser	Ala	Ser	Lys	Ala	Asn	Pro	Asn	Gly	
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Asp	Lys	Gln	Gly	Trp	Phe	Phe	Phe	Ala	Leu	Ile	Val	Ala	Ile	Val	Gly	
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atc	ttg	acc	tca	att	acc	gtt	ggt	ctt	ggt	act	cac	gaa	gta	aaa	tcc	649
Ile	Leu	Thr	Ser	Ile	Thr	Val	Gly	Leu	Gly	Thr	His	Glu	Val	Lys	Ser	

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165	170	175	
gcc ctg cg <sup>g</sup> gaa agc aat gaa aag acc act ttg aag cag gtc ttt aag		697	
Ala Leu Arg Glu Ser Asn Glu Lys Thr Thr Leu Lys Gln Val Phe Lys			
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gtc ctg ggg caa aac gac cag ctc ctc tgg ctg gcc ttt gcc tac tgg		745	
Val Leu Gly Gln Asn Asp Gln Leu Leu Trp Leu Ala Phe Ala Tyr Trp			
195	200	205	
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Phe Tyr Gly Leu Gly Ile Asn Thr Leu Asn Ala Leu Gln Leu Tyr Tyr			
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Phe Ser Tyr Ile Leu Gly Asp Ala Arg Gly Tyr Ser Leu Leu Tyr Thr			
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atc aac acc ttt gtc ggt tta atc tct gca tcc ttc ttc cca tca ctg		889	
Ile Asn Thr Phe Val Gly Leu Ile Ser Ala Ser Phe Phe Pro Ser Leu			
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Ala Lys Lys Phe Asn Arg Asn Arg Leu Phe Tyr Ala Cys Ile Ala Val			
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Met Leu Leu Gly Ile Gly Val Phe Ser Val Ala Ser Gly Ser Leu Ala			
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ctg tcc ctt gtt ggg gca gaa ttc ttc ttt att ccg cag cct ctg gcc		1033	
Leu Ser Leu Val Gly Ala Glu Phe Phe Phe Ile Pro Gln Pro Leu Ala			
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ttc ctg gtc gtt ttg atg atc atc tct gac gct gtt gaa tac ggc cag		1081	
Phe Leu Val Val Leu Met Ile Ile Ser Asp Ala Val Glu Tyr Gly Gln			
305	310	315	320
ctg aaa act ggc cac aga gac gaa gct ttg acc ctg tct gtc cgg cca		1129	

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325	330	335	
ttg gtc gat aag ctg ggc ggg gcc ttg tcc aac tgg ttt gtt tcc ttg		1177	
Leu Val Asp Lys Leu Gly Gly Ala Leu Ser Asn Trp Phe Val Ser Leu			
340	345	350	
att gcc tta act gcc ggc atg acc act ggg gcg act gcc tca aca att		1225	
Ile Ala Leu Thr Ala Gly Met Thr Thr Gly Ala Thr Ala Ser Thr Ile			
355	360	365	
aca gct cat ggc cag atg gtc ttc aag tta gct atg ttt gcc tta ccg		1273	
Thr Ala His Gly Gln Met Val Phe Lys Leu Ala Met Phe Ala Leu Pro			
370	375	380	
gca gtc atg ctc ttg atc gct gtt tct att ttc gcc aaa aag gtc ttc		1321	
Ala Val Met Leu Leu Ile Ala Val Ser Ile Phe Ala Lys Lys Val Phe			
385	390	395	400
ttg act gaa gaa aag cac gcg gaa atc gtc gac cag ctg gaa act caa		1369	
Leu Thr Glu Glu Lys His Ala Glu Ile Val Asp Gln Leu Glu Thr Gln			
405	410	415	
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Phe Ser Gln Ser His Ala Gln Lys Pro Ala Gln Ala Glu Ser Phe Thr			
420	425	430	
ttg gcc agc cca gtc tcc gga caa tta atg aac ctg gac atg gtt gac		1465	
Leu Ala Ser Pro Val Ser Gly Gln Leu Met Asn Leu Asp Met Val Asp			
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Asp Pro Val Phe Ala Asp Lys Lys Leu Gly Asp Gly Phe Ala Leu Val			
450	455	460	
cca gca gac ggt aag gtc tac gcg cca ttt gcc ggt act gtc cgc cag		1561	
Pro Ala Asp Gly Lys Val Tyr Ala Pro Phe Ala Gly Thr Val Arg Gln			
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ttg	gtc	ttg	att	cac	ctt	ggc	ctg	ggc	acg	gtc	aaa	tta	aac	ggg	act	1657	
Leu	Val	Leu	Ile	His	Leu	Gly	Leu	Gly	Thr	Val	Lys	Leu	Asn	Gly	Thr		
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ggc	ttt	gtc	agc	tat	gtt	gaa	gag	ggc	agc	cag	gta	gaa	gcc	ggc	cag	1705	
Gly	Phe	Val	Ser	Tyr	Val	Glu	Glu	Gly	Ser	Gln	Val	Glu	Ala	Gly	Gln		
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Gln	Ile	Leu	Glu	Phe	Trp	Asp	Pro	Ala	Ile	Lys	Gln	Ala	Lys	Leu	Asp		
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gac	acg	gta	atc	gtg	acc	gtc	atc	aac	agc	gaa	act	ttc	gca	aat	agc	1801	
Asp	Thr	Val	Ile	Val	Thr	Val	Ile	Asn	Ser	Glu	Thr	Phe	Ala	Asn	Ser		
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cag	atg	ctc	ttg	ccg	atc	ggc	cac	agc	gtc	caa	gcc	ctg	gat	gat	gta	1849	
Gln	Met	Leu	Leu	Pro	Ile	Gly	His	Ser	Val	Gln	Ala	Leu	Asp	Asp	Val		
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Phe	Lys	Leu	Glu	Gly	Lys	Asn				Met	Ser	Asn	Lys	Leu	Val	Lys	
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Glu	Lys	Arg	Val	Asp	Gln	Ala	Asp	Leu	Ala	Trp	Leu	Thr	Asp	Pro	Glu		
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Val	Tyr	Glu	Val	Asn	Thr	Ile	Pro	Pro	His	Ser	Asp	His	Glu	Ser	Phe		
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ctg gac ggg gac tgg ctg att gac tac gct gaa aac ggc cag gga cca																2089
Leu	Asp	Gly	Asp	Trp	Leu	Ile	Asp	Tyr	Ala	Glu	Asn	Gly	Gln	Gly	Pro	
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Val	Asn	Phe	Tyr	Ala	Glu	Asp	Phe	Asp	Asp	Ser	Asn	Phe	Lys	Ser	Val	
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Lys	Val	Pro	Gly	Asn	Leu	Glu	Leu	Gln	Gly	Phe	Gly	Gln	Pro	Gln	Tyr	
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gtc aac gtc caa tat cca tgg gac ggc agt gag gag att ttc ccg ccc																2233
Val	Asn	Val	Gln	Tyr	Pro	Trp	Asp	Gly	Ser	Glu	Glu	Ile	Phe	Pro	Pro	
				690			695					700				
caa att cca agc aaa aat ccg ctc gct tct tat gtc aga tac ttt gac																2281
Gln	Ile	Pro	Ser	Lys	Asn	Pro	Leu	Ala	Ser	Tyr	Val	Arg	Tyr	Phe	Asp	
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Leu	Asp	Glu	Ala	Phe	Trp	Asp	Lys	Glu	Val	Ser	Leu	Lys	Phe	Asp	Gly	
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gcg gca aca gcc atc tat gtc tgg ctg aac ggc cac ttc gtc ggc tac																2377
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ggg gaa gac tcc ttt acc cca agc gag ttt atg gtt acc aag ttc ctc																2425
Gly	Glu	Asp	Ser	Phe	Thr	Pro	Ser	Glu	Phe	Met	Val	Thr	Lys	Phe	Leu	
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aag aaa gaa aat aac cgc ctg gca gtg gct ctc tac aag tat tct tcc																2473
Lys	Lys	Glu	Asn	Asn	Arg	Leu	Ala	Val	Ala	Leu	Tyr	Lys	Tyr	Ser	Ser	
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aga tca gtg act ctt cag gcc aag ccg cgt ctg cac ttg gag gac ctt	2569
Arg Ser Val Thr Leu Gln Ala Lys Pro Arg Leu His Leu Glu Asp Leu	
800 805 810 815	
aag ctt acg gcc agc ttg acc gat aac tac caa aaa gga aag ctg gaa	2617
Lys Leu Thr Ala Ser Leu Thr Asp Asn Tyr Gln Lys Gly Lys Leu Glu	
820 825 830	
gtc gaa gcc aat att gcc tac cgc ttg cca aat gcc agc ttt aag ctg	2665
Val Glu Ala Asn Ile Ala Tyr Arg Leu Pro Asn Ala Ser Phe Lys Leu	
835 840 845	
gaa gtg cggt gat agt gaa ggt gac ttg gtt gct gaa aag ctg ggc cca	2713
Glu Val Arg Asp Ser Glu Gly Asp Leu Val Ala Glu Lys Leu Gly Pro	
850 855 860	
atc aga agc gag cag ctg gaa ttc act ctg gct gat ttg cca gta gct	2761
Ile Arg Ser Glu Gln Leu Glu Phe Thr Leu Ala Asp Leu Pro Val Ala	
865 870 875	
gcc tgg agc gcg gaa aag cct aac ctt tac cag gtc cgc ctg tat tta	2809
Ala Trp Ser Ala Glu Lys Pro Asn Leu Tyr Gln Val Arg Leu Tyr Leu	
880 885 890 895	
tac cag gca ggc agc ctc tta gag gtt agc cggt cag gaa gtg ggt ttc	2857
Tyr Gln Ala Gly Ser Leu Leu Glu Val Ser Arg Gln Glu Val Gly Phe	
900 905 910	
cgc aac ttt gaa cta aaa gac ggg att atg tac ctt aac ggc cag cgg	2905
Arg Asn Phe Glu Leu Lys Asp Gly Ile Met Tyr Leu Asn Gly Gln Arg	
915 920 925	
atc gtc ttc aag ggg gcc aac cggt cac gaa ttt gac agt aag ttg ggc	2953
Ile Val Phe Lys Gly Ala Asn Arg His Glu Phe Asp Ser Lys Leu Gly	

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930	935	940	
cgg gct atc aca gaa gag gat atg atc tgg gat atc aag acc acc atg aag			3001
Arg Ala Ile Thr Glu Glu Asp Met Ile Trp Asp Ile Lys Thr Met Lys			
945	950	955	
cga agc aac atc aat gct gtc cgc tgc tct cac tac ccg aac cag tcc			3049
Arg Ser Asn Ile Asn Ala Val Arg Cys Ser His Tyr Pro Asn Gln Ser			
960	965	970	975
ctc ttt tac cgg ctc tgt gac aag tac ggc ctt tac gtc att gat gaa			3097
Leu Phe Tyr Arg Leu Cys Asp Lys Tyr Gly Leu Tyr Val Ile Asp Glu			
980	985	990	
gct aac ctg gaa agc cac ggc acc tgg gaa aaa gtg ggg ggg cac gaa			3145
Ala Asn Leu Glu Ser His Gly Thr Trp Glu Lys Val Gly Gly His Glu			
995	1000	1005	
gat cct agc ttc aat gtt cca ggc gat gac cag cat tgg ctg gga gcc			3193
Asp Pro Ser Phe Asn Val Pro Gly Asp Asp Gln His Trp Leu Gly Ala			
1010	1015	1020	
agc tta tcc cgg gtg aag aac atg atg gct cgg gac aag aac cat gct			3241
Ser Leu Ser Arg Val Lys Asn Met Met Ala Arg Asp Lys Asn His Ala			
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Ser Ile Leu Ile Trp Ser Leu Gly Asn Glu Ser Tyr Ala Gly Thr Val			
1040	1045	1050	1055
ttt gcc caa atg gct gat tac gtc cgg aag gct gat ccg acc cgg gtt			3337
Phe Ala Gln Met Ala Asp Tyr Val Arg Lys Ala Asp Pro Thr Arg Val			
1060	1065	1070	
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Gln His Tyr Glu Gly Val Thr His Asn Arg Lys Phe Asp Asp Ala Thr			
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cag att gaa agc cgg atg tat gct ccg gcc aag gta att gaa gaa tac			3433

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1120							1125				1130			1135	
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1215															
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Leu Pro Trp Ala Asp Glu Gly Phe Thr Val Ala Glu Ala Glu Glu Val	
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Ala Gln Lys Leu Pro Glu Phe Lys Pro Glu Gly Arg Pro Asp Leu Val	
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Asp Ser Asp Tyr Asn Leu Gly Leu Lys Gly Asn Asn Phe Gln Ile Leu	
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Phe Ser Lys Val Lys Gly Trp Pro Val Ser Leu Lys Tyr Ala Gly Arg	
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gaa tac ttg aag ccg ctg ccg gaa ttt acc ttc tgg ccg gcc ctg acg	4201
Glu Tyr Leu Lys Arg Leu Pro Glu Phe Thr Phe Trp Arg Ala Leu Thr	
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Asn Ala Gly Lys Tyr Ala Arg Leu Lys Asp Ile Ser Cys Glu Val Lys	
1380 1385 1390	
gaa gac tcc gtt ttg gtc aag act gcc ttt acg ttg cct gtc gcc tta	4345

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Glu Asp Ser Val Leu Val Lys Thr Ala Phe Thr Leu Pro Val Ala Leu  
1395 1400 1405

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Lys Gly Asp Leu Thr Val Thr Tyr Glu Val Asp Gly Arg Gly Lys Ile  
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gct gta aca gct gac ttc cca ggc gc<sup>g</sup> gaa gaa gcc ggt ctc ttg cca 4441

Ala Val Thr Ala Asp Phe Pro Gly Ala Glu Glu Ala Gly Leu Leu Pro  
1425 1430 1435

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Tyr Tyr Gly Leu Gly Pro Asn Glu Ser  
1460 1465

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Met Ile Phe Ile Ile Thr Asn Leu Ile Thr Ala Ile Arg Ile Gly Glu
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Val Leu Leu Asp Pro Leu Ile Gly Asn Ala Ile Asp Arg Thr Glu Ser
20 25 30

Arg Trp Gly Lys Phe Lys Pro Trp Val Val Gly Gly Gly Ile Ile Ser
35 40 45

Ser Leu Ala Leu Leu Ala Leu Phe Thr Asp Phe Gly Gly Ile Asn Gln
50 55 60

Ser Asn Pro Val Val Tyr Leu Val Ile Phe Gly Ile Val Tyr Leu Ile
65 70 75 80

Met Asp Ile Phe Tyr Ser Phe Lys Asp Thr Gly Phe Trp Ala Met Ile
85 90 95

Pro Ala Leu Ser Leu Asp Ser Arg Glu Arg Glu Lys Thr Ser Thr Phe
100 105 110

Ala Arg Val Gly Ser Thr Ile Gly Ala Asn Leu Val Gly Val Val Ile
115 120 125

Thr Pro Ile Ile Leu Phe Phe Ser Ala Ser Lys Ala Asn Pro Asn Gly
130 135 140

Asp Lys Gln Gly Trp Phe Phe Phe Ala Leu Ile Val Ala Ile Val Gly
145 150 155 160

Ile Leu Thr Ser Ile Thr Val Gly Leu Gly Thr His Glu Val Lys Ser
165 170 175

Ala Leu Arg Glu Ser Asn Glu Lys Thr Thr Leu Lys Gln Val Phe Lys
180 185 190

Val Leu Gly Gln Asn Asp Gln Leu Leu Trp Leu Ala Phe Ala Tyr Trp
195 200 205

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Phe Tyr Gly Leu Gly Ile Asn Thr Leu Asn Ala Leu Gln Leu Tyr Tyr  
210 215 220

Phe Ser Tyr Ile Leu Gly Asp Ala Arg Gly Tyr Ser Leu Leu Tyr Thr  
225 230 235 240

Ile Asn Thr Phe Val Gly Leu Ile Ser Ala Ser Phe Phe Pro Ser Leu  
245 250 255

Ala Lys Lys Phe Asn Arg Asn Arg Leu Phe Tyr Ala Cys Ile Ala Val  
260 265 270

Met Leu Leu Gly Ile Gly Val Phe Ser Val Ala Ser Gly Ser Leu Ala  
275 280 285

Leu Ser Leu Val Gly Ala Glu Phe Phe Ile Pro Gln Pro Leu Ala  
290 295 300

Phe Leu Val Val Leu Met Ile Ile Ser Asp Ala Val Glu Tyr Gly Gln  
305 310 315 320

Leu Lys Thr Gly His Arg Asp Glu Ala Leu Thr Leu Ser Val Arg Pro  
325 330 335

Leu Val Asp Lys Leu Gly Gly Ala Leu Ser Asn Trp Phe Val Ser Leu  
340 345 350

Ile Ala Leu Thr Ala Gly Met Thr Thr Gly Ala Thr Ala Ser Thr Ile  
355 360 365

Thr Ala His Gly Gln Met Val Phe Lys Leu Ala Met Phe Ala Leu Pro  
370 375 380

Ala Val Met Leu Leu Ile Ala Val Ser Ile Phe Ala Lys Lys Val Phe  
385 390 395 400

Leu Thr Glu Glu Lys His Ala Glu Ile Val Asp Gln Leu Glu Thr Gln  
405 410 415

Phe Ser Gln Ser His Ala Gln Lys Pro Ala Gln Ala Glu Ser Phe Thr  
420 425 430

Leu Ala Ser Pro Val Ser Gly Gln Leu Met Asn Leu Asp Met Val Asp  
435 440 445

Asp Pro Val Phe Ala Asp Lys Lys Leu Gly Asp Gly Phe Ala Leu Val  
450 455 460

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Pro Ala Asp Gly Lys Val Tyr Ala Pro Phe Ala Gly Thr Val Arg Gln  
465 470 475 480

Leu Ala Lys Thr Arg His Ser Ile Val Leu Glu Asn Glu His Gly Val  
485 490 495

Leu Val Leu Ile His Leu Gly Leu Gly Thr Val Lys Leu Asn Gly Thr  
500 505 510

Gly Phe Val Ser Tyr Val Glu Glu Gly Ser Gln Val Glu Ala Gly Gln  
515 520 525

Gln Ile Leu Glu Phe Trp Asp Pro Ala Ile Lys Gln Ala Lys Leu Asp  
530 535 540

Asp Thr Val Ile Val Thr Val Ile Asn Ser Glu Thr Phe Ala Asn Ser  
545 550 555 560

Gln Met Leu Leu Pro Ile Gly His Ser Val Gln Ala Leu Asp Asp Val  
565 570 575

Phe Lys Leu Glu Gly Lys Asn  
580

<210> 3

<211> 880

<212> PRT

<213> Lactobacillus bulgaricus

<400> 3

Met Ser Asn Lys Leu Val Lys Glu Lys Arg Val Asp Gln Ala Asp Leu  
1 5 10 15

Ala Trp Leu Thr Asp Pro Glu Val Tyr Glu Val Asn Thr Ile Pro Pro  
20 25 30

His Ser Asp His Glu Ser Phe Gln Ser Gln Glu Glu Leu Glu Glu Gly  
35 40 45

Lys Ser Ser Leu Val Gln Ser Leu Asp Gly Asp Trp Leu Ile Asp Tyr  
50 55 60

Ala Glu Asn Gly Gln Gly Pro Val Asn Phe Tyr Ala Glu Asp Phe Asp  
65 70 75 80

Asp Ser Asn Phe Lys Ser Val Lys Val Pro Gly Asn Leu Glu Leu Gln  
85 90 95

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Gly Phe Gly Gln Pro Gln Tyr Val Asn Val Gln Tyr Pro Trp Asp Gly  
100 105 110

Ser Glu Glu Ile Phe Pro Pro Gln Ile Pro Ser Lys Asn Pro Leu Ala  
115 120 125

Ser Tyr Val Arg Tyr Phe Asp Leu Asp Glu Ala Phe Trp Asp Lys Glu  
130 135 140

Val Ser Leu Lys Phe Asp Gly Ala Ala Thr Ala Ile Tyr Val Trp Leu  
145 150 155 160

Asn Gly His Phe Val Gly Tyr Gly Glu Asp Ser Phe Thr Pro Ser Glu  
165 170 175

Phe Met Val Thr Lys Phe Leu Lys Lys Glu Asn Asn Arg Leu Ala Val  
180 185 190

Ala Leu Tyr Lys Tyr Ser Ser Ala Ser Trp Leu Glu Asp Gln Asp Phe  
195 200 205

Trp Arg Met Ser Gly Leu Phe Arg Ser Val Thr Leu Gln Ala Lys Pro  
210 215 220

Arg Leu His Leu Glu Asp Leu Lys Leu Thr Ala Ser Leu Thr Asp Asn  
225 230 235 240

Tyr Gln Lys Gly Lys Leu Glu Val Glu Ala Asn Ile Ala Tyr Arg Leu  
245 250 255

Pro Asn Ala Ser Phe Lys Leu Glu Val Arg Asp Ser Glu Gly Asp Leu  
260 265 270

Val Ala Glu Lys Leu Gly Pro Ile Arg Ser Glu Gln Leu Glu Phe Thr  
275 280 285

Leu Ala Asp Leu Pro Val Ala Ala Trp Ser Ala Glu Lys Pro Asn Leu  
290 295 300

Tyr Gln Val Arg Leu Tyr Leu Tyr Gln Ala Gly Ser Leu Leu Glu Val  
305 310 315 320

Ser Arg Gln Glu Val Gly Phe Arg Asn Phe Glu Leu Lys Asp Gly Ile  
325 330 335

Met Tyr Leu Asn Gly Gln Arg Ile Val Phe Lys Gly Ala Asn Arg His  
340 345 350

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Glu Phe Asp Ser Lys Leu Gly Arg Ala Ile Thr Glu Glu Asp Met Ile  
355 360 365

Trp Asp Ile Lys Thr Met Lys Arg Ser Asn Ile Asn Ala Val Arg Cys  
370 375 380

Ser His Tyr Pro Asn Gln Ser Leu Phe Tyr Arg Leu Cys Asp Lys Tyr  
385 390 395 400

Gly Leu Tyr Val Ile Asp Glu Ala Asn Leu Glu Ser His Gly Thr Trp  
405 410 415

Glu Lys Val Gly Gly His Glu Asp Pro Ser Phe Asn Val Pro Gly Asp  
420 425 430

Asp Gln His Trp Leu Gly Ala Ser Leu Ser Arg Val Lys Asn Met Met  
435 440 445

Ala Arg Asp Lys Asn His Ala Ser Ile Leu Ile Trp Ser Leu Gly Asn  
450 455 460

Glu Ser Tyr Ala Gly Thr Val Phe Ala Gln Met Ala Asp Tyr Val Arg  
465 470 475 480

Lys Ala Asp Pro Thr Arg Val Gln His Tyr Glu Gly Val Thr His Asn  
485 490 495

Arg Lys Phe Asp Asp Ala Thr Gln Ile Glu Ser Arg Met Tyr Ala Pro  
500 505 510

Ala Lys Val Ile Glu Glu Tyr Leu Thr Asn Lys Pro Ala Lys Pro Phe  
515 520 525

Ile Ser Val Glu Tyr Ala His Ala Met Gly Asn Ser Val Gly Asp Leu  
530 535 540

Ala Ala Tyr Thr Ala Leu Glu Lys Tyr Pro His Tyr Gln Gly Gly Phe  
545 550 555 560

Ile Trp Asp Trp Ile Asp Gln Gly Leu Glu Lys Asp Gly His Leu Leu  
565 570 575

Tyr Gly Gly Asp Phe Asp Asp Arg Pro Thr Asp Tyr Glu Phe Cys Gly  
580 585 590

Asn Gly Leu Val Phe Ala Asp Arg Thr Glu Ser Pro Lys Leu Ala Asn  
595 600 605

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Val Lys Ala Leu Tyr Ala Asn Leu Lys Leu Glu Val Lys Asp Gly Gln  
610 615 620

Leu Phe Leu Lys Asn Asp Asn Leu Phe Thr Asn Ser Ser Ser Tyr Tyr  
625 630 635 640

Phe Leu Thr Ser Leu Leu Val Asp Gly Lys Leu Thr Tyr Gln Ser Arg  
645 650 655

Pro Leu Thr Phe Gly Leu Glu Pro Gly Glu Ser Gly Thr Phe Ala Leu  
660 665 670

Pro Trp Pro Glu Val Ala Asp Glu Lys Gly Glu Val Val Tyr Arg Val  
675 680 685

Thr Ala His Leu Lys Glu Asp Leu Pro Trp Ala Asp Glu Gly Phe Thr  
690 695 700

Val Ala Glu Ala Glu Glu Val Ala Gln Lys Leu Pro Glu Phe Lys Pro  
705 710 715 720

Glu Gly Arg Pro Asp Leu Val Asp Ser Asp Tyr Asn Leu Gly Leu Lys  
725 730 735

Gly Asn Asn Phe Gln Ile Leu Phe Ser Lys Val Lys Gly Trp Pro Val  
740 745 750

Ser Leu Lys Tyr Ala Gly Arg Glu Tyr Leu Lys Arg Leu Pro Glu Phe  
755 760 765

Thr Phe Trp Arg Ala Leu Thr Asp Asn Asp Arg Gly Ala Gly Tyr Gly  
770 775 780

Tyr Asp Leu Ala Arg Trp Glu Asn Ala Gly Lys Tyr Ala Arg Leu Lys  
785 790 795 800

Asp Ile Ser Cys Glu Val Lys Glu Asp Ser Val Leu Val Lys Thr Ala  
805 810 815

Phe Thr Leu Pro Val Ala Leu Lys Gly Asp Leu Thr Val Thr Tyr Glu  
820 825 830

Val Asp Gly Arg Gly Lys Ile Ala Val Thr Ala Asp Phe Pro Gly Ala  
835 840 845

Glu Glu Ala Gly Leu Leu Pro Ala Phe Gly Leu Asn Leu Ala Leu Pro  
850 855 860

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Lys Glu Leu Thr Asp Tyr Arg Tyr Tyr Gly Leu Gly Pro Asn Glu Ser  
865 870 875 880